deepening of feeling. And if natural history is asked to give hints to the human educationist, one of them is this: "Youth should be spent in blunting (a term apt to be misunderstood?) every instinct, in awakening and stimulating every curiosity, in the gayest roving, in the wildest experiment. The supreme duty of youth is to try all things."

MANUALS OF BOTANY.

(1) *Pflanzenmikrochemie. Ein Hilfsbuch beim mikrochemischen Studium pflanzlicher Objekte.* By Dr. O. Tunmann. Pp. xx + 631. (Berlin: Gebrüder Borntraeger, 1913). Price 18.50 marks.

(2) *Researches on Irritability of Plants.* By Prof. J. C. Bose. Pp. xxiv + 376. (London: Longmans, Green and Co., 1913.) Price 7*s.* 6*d.* net.

(3) *Plants and their Uses. An Introduction to Botany.* By F. L. Sargent. Pp. x + 620. (New York: Henry Holt and Co., 1913.)

(1) BOTANISTS who have not kept in touch with the more recent advances in the microchemistry of plants will be surprised at the size of this work with its 600 closely-printed pages. The book is divided into a general and a special part. In the first part we have, first, sixty pages dealing with methods of preparing and preserving material and with various other special methods such as filtering, centrifuging, sedimentation, micro-sublimation (a method of great value in many cases), clearing, swelling, bleaching, maceration, etc. In the second part the methods of recognising the various elements of the ordinary inorganic substances of the plant are considered, and later the various classes of organic substances are dealt with fully. The author, however, does not stop here, but in the last 200 pages passes in review the microscopical characters and the chemical nature of protoplasm, cell-wall, and cell-inclusions generally; this section includes details of fixing and of the staining reactions of the various cell elements. It will be seen that the author interprets his subject very broadly as, in fact, coextensive with botanical microtechnique.

The need for such a book is very obvious since the last work covering such a field was very much smaller and was published in 1892. Dr. Tunmann has made many contributions himself to the study of plant microchemistry, and no one could be better fitted to prepare such a work.

The literature of the subject has been worked up in a way which must have taken years to complete and nearly every page bristles with references; the work is, however, no mere compilation, for the physiological aspects of the different substances are briefly dealt with and many methods critically discussed. Of course, it is impossible to read and criticise this book as a whole, but when tested in relation to a number of diverse substances, such as the microscopical recognition of potassium, of formaldehyde, of sugars, etc., it has proved to be thoroughly up-to-date. Botanists, plant biochemists, and those who have to deal with the recognition of vegetable tissues and drugs used in pharmacy are under a heavy debt of gratitude to the author. The book should be on the shelves of every botanical, biochemical, and pharmaceutical library.

(2) This volume is the fourth of the series of books in which Prof. Bose has applied the delicate methods of the physical laboratory to the study of the irritable responses of plants and animals. As his previous work has shown, the author looks upon the plant as a very peculiar machine of which the sole source of energy is that which plays upon it directly from without! Such views, however, should not blind plant physiologists, and animal physiologists interested in the neuro-muscular electrical response, to the solid value of many of the results obtained and to the usefulness of the ingenious and delicate apparatus devised by the author. His resonant recorder is a beautiful piece of apparatus in which the recording lever is made to vibrate to and fro and so to make only an *intermittent* contact with the recording surface; the friction between the lever and blackened surface is thus enormously reduced. By means of this apparatus and of another ingenious instrument, the oscillating recorder, the delicate movements of the leaves of Mimosa and Biophytum have been recorded for the first time without distortion, and so the latent period and the rate of transmission of a stimulus carefully measured. Very good reasons are given for the belief that in Mimosa an impulse cannot pass through dead tissues, in the manner commonly accepted, as a mere hydro-mechanical disturbance, but only through living protoplasm, the mode of transmission being essentially similar to that of a nervous impulse.

There is much other work of importance, especially in connection with electrical responses, and one is glad to note that startlingly unorthodox views are much rarer than in previous works. Prof. Bose, however, must be unaware of, or careless of, the prejudices of biologists or he would not put forward, without the support of further experiments, the conclusion that in a bean leaf "on account of fatigue, the death point was lowered from the normal 60° C. to 37° C."

(3) This book is described as an introduction to botany. The plan of the work is based on the

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view that the beginner in botany should first learn about economic plants and classify them scientifically and later deal with other aspects of the subject. In accordance with this view it begins with a preliminary chapter on the way in which botany arose, how plants are named, and the nature of varieties, species, and genera. In the next chapter, thirty-four pages are devoted to the cereals; the characteristics, floral and otherwise, of the various forms are described, maps of their probable origin and present distribution are given, and their suitability to various habitats pointed out. At the end of this chapter, the nutritive value of the grain of various cereals is considered, and the nature of carbohydrates, proteids, and fats briefly indicated. In the third chapter, other food plants are considered, such as nuts, pulse, earth-vegetables, herbage-vegetables, fruit-vegetables, and miscellaneous food-products. After this review of the chief food-plants a discussion of food as a fuel and building material is provided, and the energy available in fats, carbohydrates, and proteids is considered, leading finally to the question of the composition of a suitable ration. Then we have chapters on flavouring and beverage plants, on medicinal and poisonous plants, and on industrial plants, *i.e.* plants yielding fibres, wood, gums, fuel, etc. Then follow chapters on classification, and on the parts of a flowering plant, and a chapter on evolution, adaptation, and natural selection. At the end of the book the chief groups of algæ, fungi, liverworts, mosses, and pteridophyta are all surveyed in no more than eighty pages. Finally we have a chapter on the plant's place in nature, which includes a semi-philosophical discussion of the distinction between the living and the non-living.

This brief statement of the contents of the book will show that the author has great faith in the powers of mental digestion of beginners, and does not hesitate to provide them with plenty of "fine, confused feeding." The earlier chapters of the books might perhaps be usefully read by an advanced student interested in the economic side of the subject and in classification, but they are almost too full of information to be used other than for reference. As an introduction to botany, however, the book is an anachronism. It might have been so used when classification practically embraced the whole subject, but nowadays it is generally agreed that the student should gain as early as possible a clear conception of the plant as a working whole. But in this book the student may peruse 500 pages without gaining any clear idea of the function of the parts of the plant. There is no description of the internal structure of a stem, root, or leaf of a flowering plant, or any mention of a chloroplast, or any description of a cell of a higher plant. Useful as the earlier chapters may be to other readers, the book appears to be quite unsuitable for a beginner, who should not be plagued too severely with information, but by proper selection of material should be led to acquire sound general views of his subject. The author states that he has "tried to write such a book as I believe would have been most useful to me as a beginner." If the author has really succeeded in recapturing his impressions as a tyro in the subject, his needs must have been very different from that of any elementary student that the reviewer has ever met.

V. H. B.

GERMAN POPULAR SCIENCE.

(1) *Bücher der Naturwissenschaft.* Edited by Prof. Siegmund Günther. 21 vols. (Leipzig: Philipp Reclam, jun., n.d.) Price 1 mark each.

(2) *Aus Natur und Geisteswelt: Sammlung wissenschaftlich-gemeinverständlicher Darstellungen.* 442 vols. (Leipzig: B. G. Teubner, n.d.) Price 1.25 marks each.

(3) *Naturwissenschaftliche Bibliothek für Jugend und Volk.* Edited by Konrad Höller and Georg Ulmer. 23 vols. (Leipzig: Quelle und Meyer, n.d.) Price 1.80 marks each.

(4) *Series of Science Books for Austrian Secondary Schools.* Published by F. Tempsky, Vienna, and G. Freytag, G.m.b.H., Leipzig. Price 2 to 5 kronen each.

(1) THE idea underlying Dr. Günther's series is to select a limited area of some scientific subject, and to treat it in a modern and popular manner which combines attractiveness with accuracy. Some of the latest volumes of this series are Lampert's "Vom Keim zum Leben," a very readable account of plant and animal development; Prof. Wieleitner's "Schnee und Eis der Erde," nicely illustrated with photographs of "penitents" and other remarkable ice formations; Dr. Hempelmann's "Der Wirbeltier-Körper," a useful though rapid summary of comparative vertebrate anatomy; Prof. Pahde's "Meereskunde," in which the latest results, such as those of the hydrodynamical theory of ocean currents, are clearly brought to bear; Dr. Speter's "Chemische Verwandtschaft," and Heinrich Leiser's "Welt der Kolloide," the latter a fascinating presentation of the rapidly growing science of colloids; and an excellent little manual on heat by the late Robert Geigel.

(2) Teubner's "Natur und Geisteswelt" series is an exceptionally large undertaking of the same kind. Among typical recent volumes may be cited a very valuable booklet by Max Verworn

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